

COUPP-2L Instrumentation Wiring

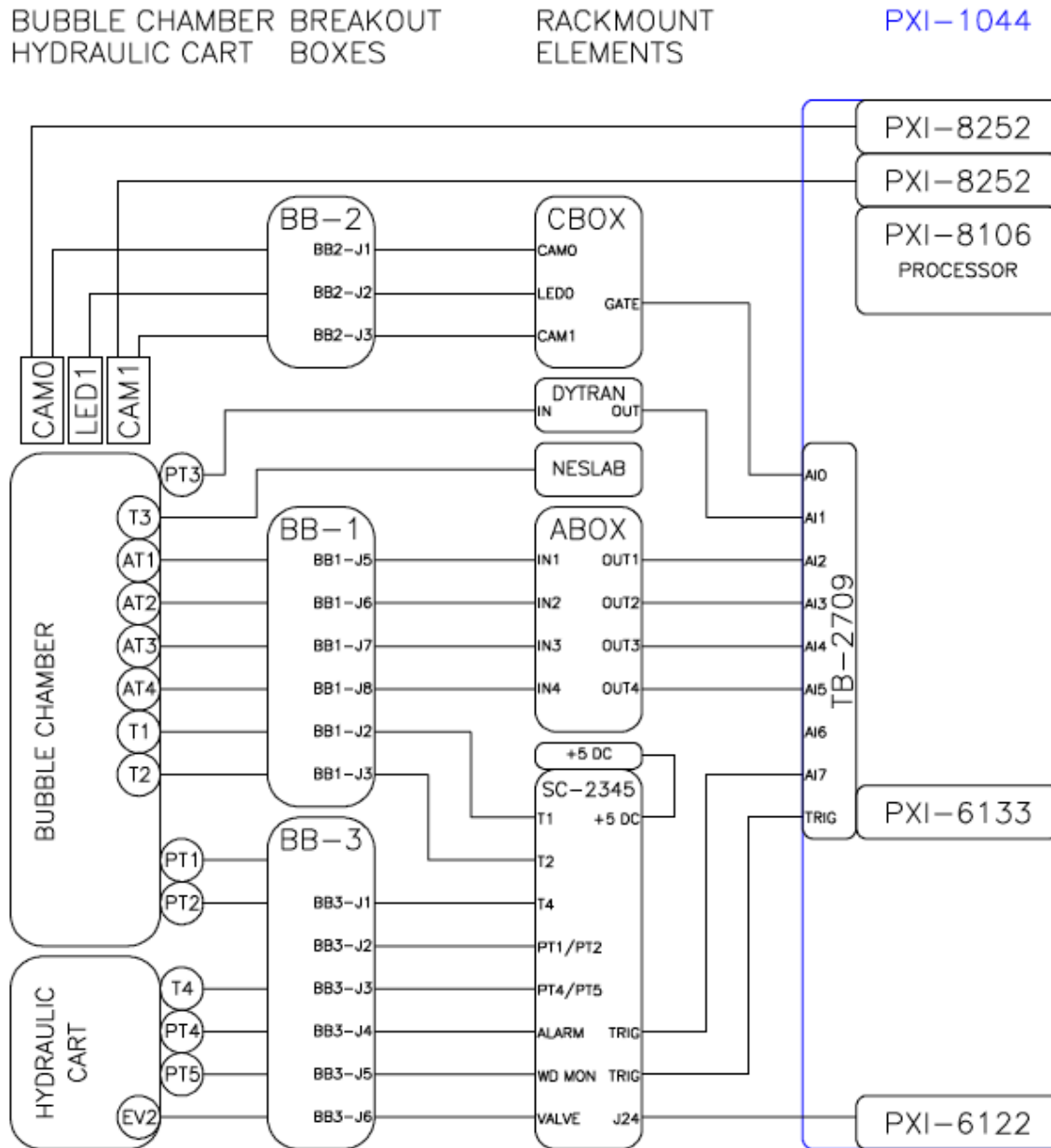


Figure 1: Top Level Instrumentation Wiring Diagram for the COUPP-2L Experiment. The bubble chamber and its hydraulic controls cart are indicated in the left column. Continuing from left to right, the second column indicates the instrumentation wiring breakout boxes on the chamber and on the hydraulic cart, the third column indicates the various instrumentation elements located in the DAQ rack, and the right-most column indicates the elements of the National Instruments Data Acquisition Chassis.

COUPP-2L Instrument Wiring Notes:

Bubble Chamber Instrumentation: The bubble chamber pressure vessel assembly is indicated schematically on the left side of Figure 1. The instrumentation attached directly to the bubble chamber:

- 1) Two video cameras denoted CAM0 and CAM1 on the drawing. These units are commercial BASLER A602f 100Hz FireWire video cameras. The cameras mounted external to the pressure vessel and view the quartz inner vessel assembly in small-angle stereo through one of the pressure-rated viewports. Each camera is equipped with a FireWire connector and a 10-pin J45 control cable. The FireWire is directly cabled from the cameras to FireWire interface ports in the PXI data acquisition crate. The control cables are wired to the BB-2 breakout box.
 - a. Link: [Basler A602f FireWire Camera](#)
- 2) One “homemade” LED Array consisting of seven Luxeon Star LED units mounted on an aluminum bracket and wired in series. The LED array is mounted external to the chamber in between the two cameras. The back wall of the chamber is lined with 3M retro-reflecting material which provides an illuminated backdrop against which to photograph the chamber (and the bubbles.) The LED Array is wired into the BB-2 breakout box.
 - a. Link: [Homemade LED Array](#)
- 3) Four custom acoustic transducers AT1, AT2, AT3, and AT4. These are custom units developed and fabricated at Indiana University South Bend and glued directly to the quartz inner vessel of the COUPP-2L bubble chamber. These sensors are wired to the external breakout box BB-1 via a pressure rated multi-conductor (16 twisted pair) electrical feed-through:
 - a. Link: [Pressure Vessel Electrical Feed-Through Information](#)
 - b. Link: [Acoustic Transducer Information](#)
- 4) Four temperature transducers. These are conventional, commercial RTD devices located on the bellows flanges of the inner vessel assembly. Each device is inserted into a loose-fitting hole and bonded with silver epoxy. The signal wires for these devices are carried through the same electrical feed-through as the acoustic transducers. T1 and T3 are located on the lower bellows flange, and T2 is located on the upper bellows flange. T1, T2, and T3 and are wired through the multi-conductor (16 twisted pair) pressure rated feed through (shared with the acoustic transducers) to the external breakout box BB-1. T4 is located on the hydraulic cart and is wired to the BB-3 breakout box.
 - a. Link: [Sensortec RTD Data Sheet](#)

- 5) Four conventional slow pressure transducers. PT1 and PT2 are located on the bubble chamber top flange. PT1 sees the hydraulic pressure in the pressure vessel, and PT2 sees the inner vessel pressure directly. PT4 and PT5 are located on the hydraulic cart. PT4 provides an additional measurement of the hydraulic fluid pressure, and PT5 provides a direct measurement of local atmospheric pressure. PT1, PT2, PT4, and PT5 are wired directly into the BB-3 breakout box. The BB-3 breakout provides the 24V bias to the pressure transducers. The pressure transducers are also indicated on the process flow diagram for the experiment.
 - a. Link: [Setra GCT225 Pressure Transducers](#)
 - b. Link: [COUPP-2L Process Diagram](#)
- 6) One fast AC-coupled pressure transducer. This device is a DYTRAN 2005V. The DYTRAN 2005V is cabled directly to a DYTRAN bias current source located in the DAQ rack.
 - a. Link: [Dytran 2005V Fast Pressure Transducer](#)

The Instrumentation Breakout Boxes: There are two instrumentation breakout boxes on the bubble chamber:

- 1) BB-1 is mounted on the bubble chamber top flange and provides access to signals originating on the bubble chamber inner vessel or on the top flange itself.
- 2) BB-2 is mounted at the base of the bubble chamber pressure vessel and provides a centralization point for signals that originate on the pressure vessel.
- 3) BB-3 designates an auxiliary wiring box that has been added external to the main electronics cabinet of the hydraulic controls cart.
 - a. Link: [Hydraulic Cart Documentation](#)
 - b. Link: [Hydraulic Cart Mods and Auxiliary Box Wiring](#)
- 4) The details of the wiring, from the instruments themselves to the DAQ system are spelled out in the COUPP-2L Instrument Wiring Table.
 - a. Link: [COUPP-2L Instrumentation Wiring Table](#)

Relay Rack Elements:

- 1) CBOX or Camera/LED/Clock Interface Box: This is a custom unit that provides the clock signal for the cameras, interfaces the camera control signals, and provides current source to drive the LED array when either camera is active.
 - a. Link: [Upgraded LED Driver for COUPP-2010](#)

- 2) DYTRAN Bias Box: This is a commercial DYTRAN 4112B Current Source and amplifier unit that provides the sensor biasing and signal processing for the DYTRAN 2005V fast pressure transducer.
 - a. Link: [DYTRAN Pressure Transducer and Bias Unit](#)
- 3) NOTE: The NESLAB Heater Chiller Unit is not in the relay rack. I just needed a place to terminate this wire on the diagram. For COUPP-2L-2010, we've added an additional temperature transducer T3 which wires directly to the external sensor input of our NESLAB RTE-740 heater/chiller unit.
 - a. Link: [NESLAB RTE-740 User's Manual](#)
 - b. Link: [NESLAB External Temperature Sensor Custom Cable](#)
- 4) ABOX or Acoustic Sensor Bias Box: This is a custom unit designed and fabricated by the Fermilab Particle Physics Division EE Department. It provides the +5 and -5 volt bias voltages for preamplifier boards encapsulated in our acoustic transducer packages (AT1 thru AT4 in the process flow diagram.)
 - a. Link: [Acoustic Transducer Bias & Breakout](#)
- 5) SC-2345 Instrumentation Wiring Chassis: This is the central instrumentation wiring nexus for the National Instruments DAQ. Documentation of the SC02345 Hardware and the details of the user-supplied wiring internal to the SC-2345 are provided in the links below:
 - a. SC-2345 Links: [SC-2345 Instrument Signal Conditioning](#)
 - b. SC-2345 Wiring: [SC-2345 Internal Wiring](#)
- 6) The National Instruments PXI Chassis with Embedded Processor and Data Acquisition Elements:
 - a. Link: [National Instruments PXI Documentation](#)